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APPLICATIONS OF ERTS-1 DATA COLLECTION SYSTEM (DCS) IN THE ARIZONA REGIONAL ECOLOGICAL TEST SITE (ARETS)

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15. Supplementary Notes

16. Abstract The DCS water-stage data from the USGS streamflow-gaging station on the Verde River near Camp Verde furnished information sufficient for the accurate computation of daily mean streamflow rates during the first 2 months of operation. Daily mean flow rates computed from the DCS data agreed with those computed from the digital-recorder data within ±5 percent during periods of stable or slowly changing flow and within ±10 percent during periods of rapidly changing high flow. The SRP was furnished near-real time DCS information on snow-moisture content and streamflow rates for use in the management and operation of the multiple-use reservoir system between March 15 and May 22, 1973. The SRP, by prudent water management and the use of near-real time hydrologic data furnished by microwave and ERTS DCS telemetry, was successful in anticipating the amount of flow into the Salt and Verde Rivers and in the subsequent release of water at rates that did not create flooding in metropolitan Phoenix. Only minor flooding occurred along the Gila River west of Phoenix. According to the Maricopa County Civil Defense agency, wage and salary losses of about $11,400,000 resulted from the closing of roads across the Salt River in the Phoenix metropolitan area in the winter and spring of 1972-73; however, the number and duration of the closings were minimized, in part, by using the DCS data. Complete estimates of other economic losses, such as the cost of road and bridge repairs and replacements, are not available at the present time.

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Type II Progress Report
ERTS-1

a. TITLE: Applications of ERTS-1 Data Collection System (DCS) in Arizona Regional Ecological Test Site (ARETS)

ERTS-1 Proposal No. SR 184

b. GSFC ID No. of P.I. IN 066

c. Statement and explanation of problems impeding the progress o the investigation:

Delays in the receipt of the digital water-stage recorders, development of necessary interface equipment, and problems with connecting cables delayed the instrumentation at some DCS sites. Field installation and operational checking required much more time than was anticipated.

The Data Collection Platform (DCP) scheduled for installation on a meteorological site at lat 33°11' N.; long 110°13' W. was not deployed for use in connection with the associated experiment "Relation of ERTS-1 Data to Evapotranspiration, Gila River Basin, Arizona (MMC No. 254)" because the evapotranspiration experiment was not funded. The platform was held in reserve as a spare for use on other key DCS hydrologic sites in central Arizona.

Two large fiberglass equipment shelters were constructed, and one was installed at the meteorological site near Wittman, Ariz. The second shelter, which was designed for use at the snow-moisture-content

site near Baker Butte, could not be installed owing to snow depths of more than 4 feet. The deep snow necessitated the construction and temporary installation of a smaller portable fiberglass equipment shelter at this site.

d. Accomplishments during reporting period:

Five DCP's were installed in the Arizona Regional Ecological Test Site area. Three DCP's were installed on U.S. Geological Survey streamflow-gaging stations on the Verde, Black, and Gila Rivers. The streamflow-gaging stations were equipped with Stevens digital water-stage recorders with telemetry capability. A meteorological station for measuring precipitation and soil and air temperatures near Wittman and a snow-moisture-content installation on Baker Butte near Payson were equipped with DCP's. Exact site locations and DCP serial numbers are given in the Data Collection Platform Status Report for this reporting period.

The large amounts of fall and winter precipitation in 1972-73 in central and eastern Arizona resulted in unseasonably large amounts of streamflow in the Gila, Salt, and Verde Rivers. Extensive flooding occurred in the Gila River Valley in eastern Arizona. The small amounts of reserve storage remaining in the multiple-use reservoirs on the Salt and Verde Rivers in central Arizona necessitated releases of water into

the normally dry channel of the Salt River that passes through metropolitan Phoenix. The multiple-use reservoirs are operated by the Salt River Project (SRP) and furnish hydroelectric power and water for municipal, industrial, and irrigation uses in the Salt River Valley in southern Arizona.

On February 21, 1973, the large potential for serious flooding in the Salt River Valley and a partial failure of the SRP microwave telemetry system precipitated an emergency request from the SRP to the U.S. Geological Survey (USGS) for DCS streamflow data for the Verde River. The USGS requested the latest DCS data from the Goddard Space Flight Center by telephone for the gaging station on the Verde River near Camp Verde, and the data were furnished in near-real time. The data enabled the USGS to furnish water management with key streamflow information to assist the SRP in the operation of reservoirs on the Verde River within 26 minutes from the time of transmission to the satellite.

By mid-March 1973, the continued high moisture levels in the Salt and Verde River watersheds had reduced the reserve reservoir storage capacity, and the large potential for flooding in the Salt River Valley presented a critical water-management situation. On March 15, 1973, the SRP requested all data on a near-real time basis from the USGS for the DCP's on their watersheds for use in the management

and operation of the SRP reservoir system. At the request of the Geological Survey, the data were furnished by the Goddard Space Flight Center directly to the Salt River Project twice daily by telephone from March 15 to May 22, 1973. Using a procedure developed by the USGS for rapid manual conversion of the DCS data into engineering units, SRP water-management personnel were able to utilize the DCS data operationally in near-real time. This critical period provided a unique opportunity to test and evaluate the operational application of the ERTS DCS to supply hydrologic information.

Plans for the next reporting period include:

1) Relocation of three DCS platforms to other USGS streamflow-gaging stations to better monitor moisture conditions on the Salt and Verde River watersheds during the coming winter runoff season.

2) Establishment of a new DCS equipped snow-moisture-content measuring site near Maverick.

3) Complete computer processing of all existing Arizona DCS data, and preparation of required data plots.

4) Development of a data-handling procedure to furnish water management with DCS data converted into engineering units through the USGS computer system.

5) Complete data analysis and preparation of final report.

e. Significant scientific results:

The DCS water-stage data from the USGS streamflow-gaging station on the Verde River near Camp Verde furnished information sufficient for the accurate computation of daily mean streamflow rates during the first ~~two~~ 2 months of operation. Daily mean flow rates computed from the DCS data agreed with those computed from the digital-recorder data within ±5 percent during periods of stable or slowly changing flow and within ±10 percent during periods of rapidly changing high flow.

The SRP was furnished near-real time DCS information on snow-moisture content and streamflow rates for use in the management and operation of the multiple-use reservoir system between March 15 and May 22, 1973. The SRP, by prudent water management and the use of near-real time hydrologic data furnished by microwave and ERTS DCS telemetry, was successful in anticipating the amount of flow into the Salt and Verde Rivers and in the subsequent release of water at rates that did not create flooding in metropolitan Phoenix. Only minor flooding occurred along the Gila River west of Phoenix.

According to the Maricopa County Civil Defense agency, wage and salary losses of about $11,400,000 resulted from the closing of

roads across the Salt River in the Phoenix metropolitan area in the winter and spring of 1972-73; however, the number and duration of the closings were minimized, in part, by using the DCS data. Complete estimates of other economic losses, such as the cost of road and bridge repairs and replacements, are not available at the present time.

The ability of the DCS to provide early warning of hydrologic-sensor failure is an unexpected and significant benefit. On several occasions the DCS furnished information on water-stage-recorder failures that prevented the loss of many weeks of valuable streamflow record.

f. Published reports: Schumann, H. H., 1973, Monitoring of streamflow in the Verde River by ERTS-1 data collection system (DCS), in Symposium on significant results obtained from the Earth Resources Technology Satellite-1: Natl. Space and Aeronautics Adm., v. 1, sec. A, p. 769-776.

g. Recommendations concerning practical changes in operations:

1) Consideration should be given to providing ERTS investigators with listings of DCS data in engineering units.

2) Consideration should be given to the standardization of hydrologic sensors for DCS applications.

3) A system should be developed for the rapid distribution of DCS data to user agencies on a national scale.

h. Changes in standing order forms: None.

i. ERTS image descriptor forms: N.A.

j. Changes in data request forms: None.

k. Status of DCP: See Data Collection Platform Status Report.